

## Geode™ GX1 Processor Series Measures Up To Low Power Consumption Expectations

### Introduction

Through a combination of smart design and state-of-the-art process technology, National has produced the National Semiconductor® Geode™ GX1 processor series, one of the lowest power-consuming processors on the market today.

As a member of the Geode family of information appliance (IA) solutions, the GX1 processor series was specifically designed to power information appliances for entertainment, education, and business. Serving the needs of consumers and business professionals alike, it is the perfect solution for IA applications such as thin clients, interactive set-top boxes, and personal internet access devices.

The GX1 processor is available with core voltages of 2.0V, 1.8V, and 1.6V, offering extremely low typical power consumption (1.2W, 1.0W, and 0.8W, respectively). Although there is no standard way to determine power consumption, National has developed a methodology that delivers a viable measurement of average power consumption that is very useful for determining battery life. This paper describes the strategy behind that methodology and how the Geode GX1 compares to the Transmeta Crusoe TM3120 processor.

### Power Management Strategy

With National's power management implementation, system performance is not sacrificed for power conservation. National has devised a simple way to achieve performance on demand. This simple, easy-to-implement power management strategy is practically a must for operating systems geared toward the IA market.

The figure below shows the four different system power states. Only Full On and Active Idle are pertinent to this discussion because they are the only two states in which operational battery life is measured.

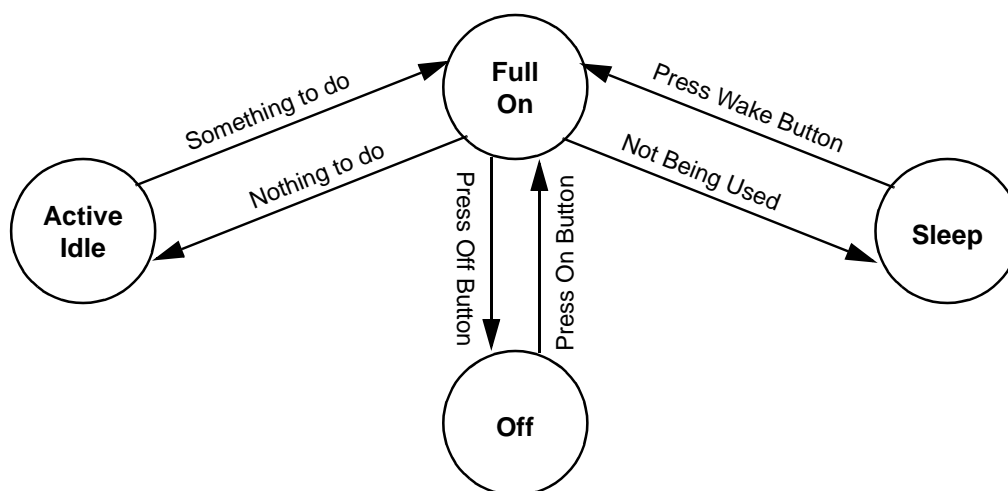
**Full On:** Everything is running; the CPU core is actively processing data.

**Active Idle:** The graphics subsystem is running and the CPU core is idle. From the user's perspective, this power state is indistinguishable from Full On; the system response is unaffected. If the system operates in this state for an extended period, the result is a significant reduction in the average power consumption.

**Sleep:** The graphics subsystem shuts down and the display turns off. This is the lowest power state in which the system can still operate.

**Off:** The system is completely off and must spend time booting when turned back on.

### System Power Management States



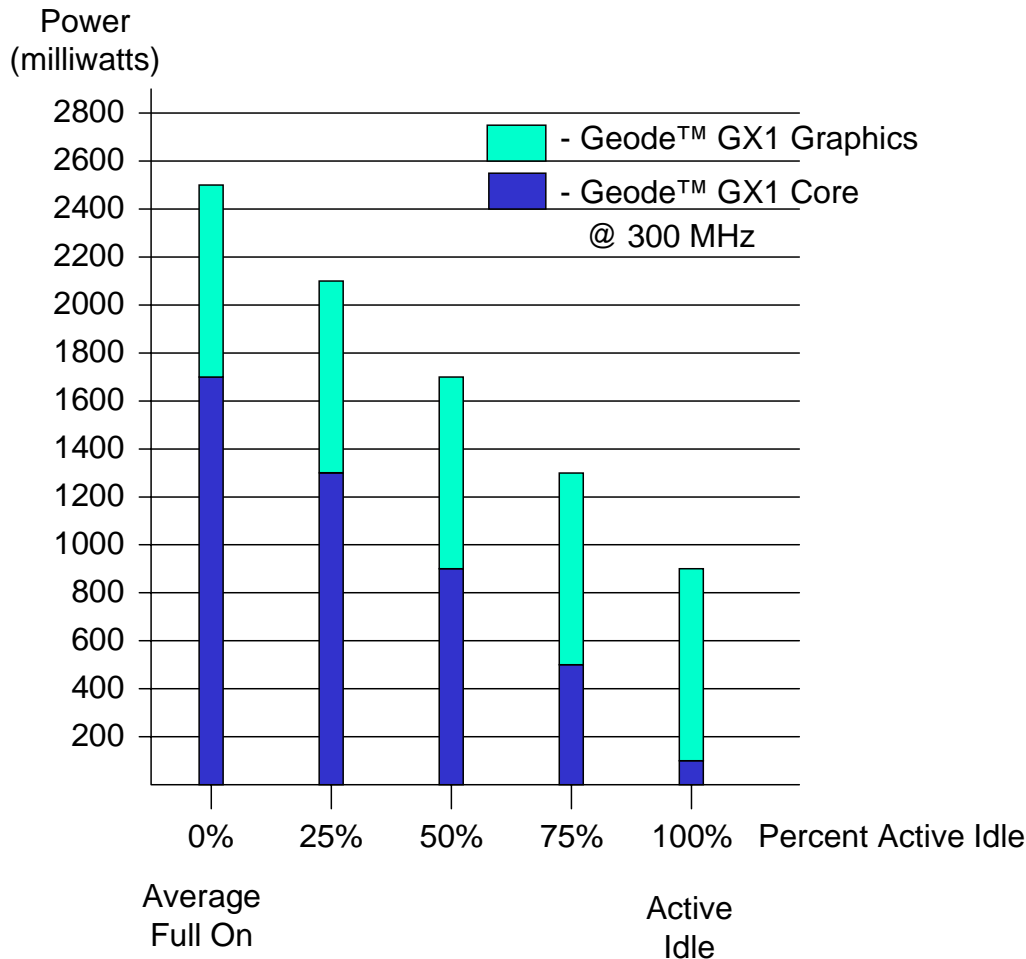
## Measuring Power Consumption in the Full On and Active Idle States

After extensive testing to determine the average power consumption for Full On, an approximated average was extracted. Further testing revealed that the GX1 processor consumed that approximated average when the system was running Microsoft Windows 95, as long as power management was disabled, preventing the system from entering Active Idle.

Since the GX1 processor includes a display controller, testing was performed on a typical system using an 800x600 display. Displaying vertical black and white stripes four pixels wide, the system consumed power within  $\pm 5\%$  of the approximated average Full On power.

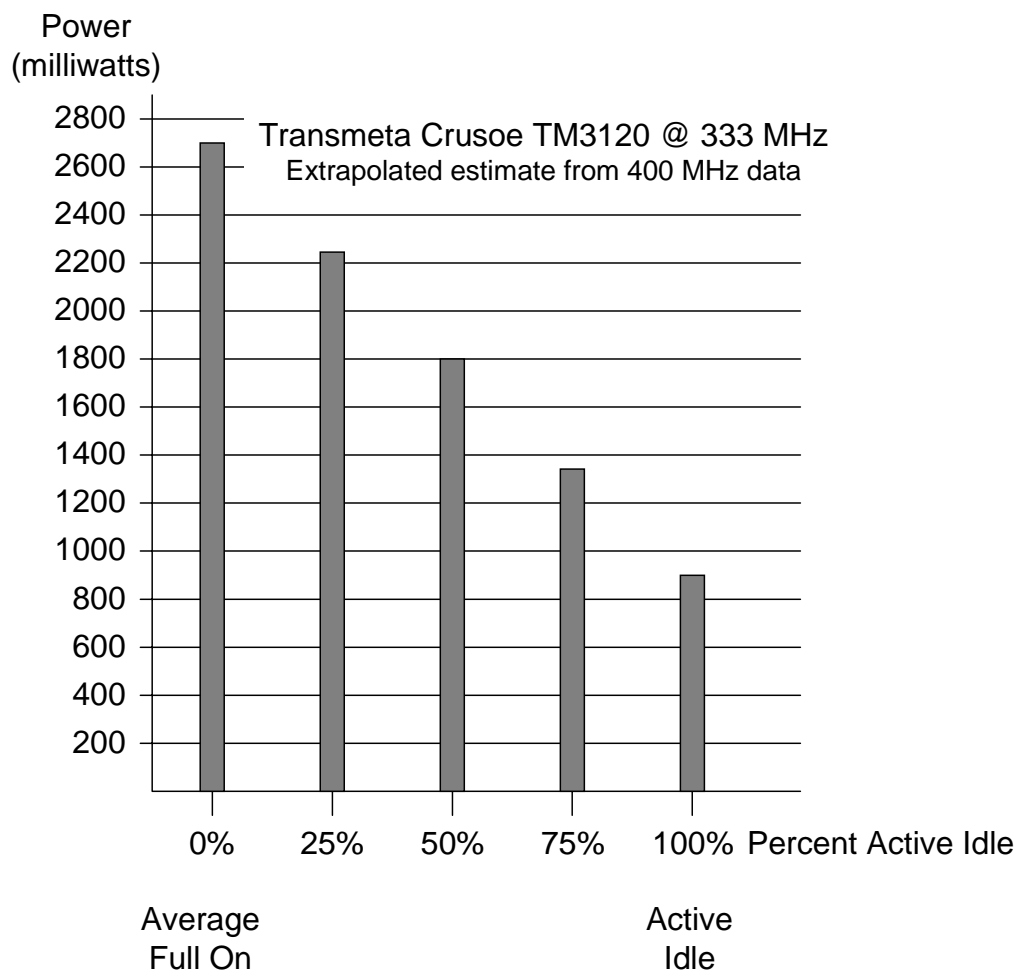
Active Idle is much easier to measure since the GX1 processor can easily be forced into the Active Idle state, at which time the power can be measured.

The chart below shows the measured power consumption of the GX1 processor at 300 MHz. The measurement breaks out the graphics and CPU core contributions to the overall total. The 0% number is the average Full On measurement. The display controller of the GX1 contributes about 800 mW of power consumption at all times. When the core is 100% Active Idle, the display controller contributes over 80% of the power consumption. The chart shows the average power consumed on a system running between Full On and Active Idle. Additional analysis conducted by National indicates that during a typical web browsing session, a system spends about 80% of the time in the Active Idle.



This chart depicts the estimated average power consumption of the Transmeta TM3120. The findings were derived by National using public domain available information. The information described measurements of the TM3120 running at 400 MHz. Using those power numbers, a linear extrapolation from 400 MHz to 333 MHz was obtained. The

result is an estimated Full On power consumption of about 2.7W. Public data indicates that the Active Idle power is 900 mW at 333 MHz.

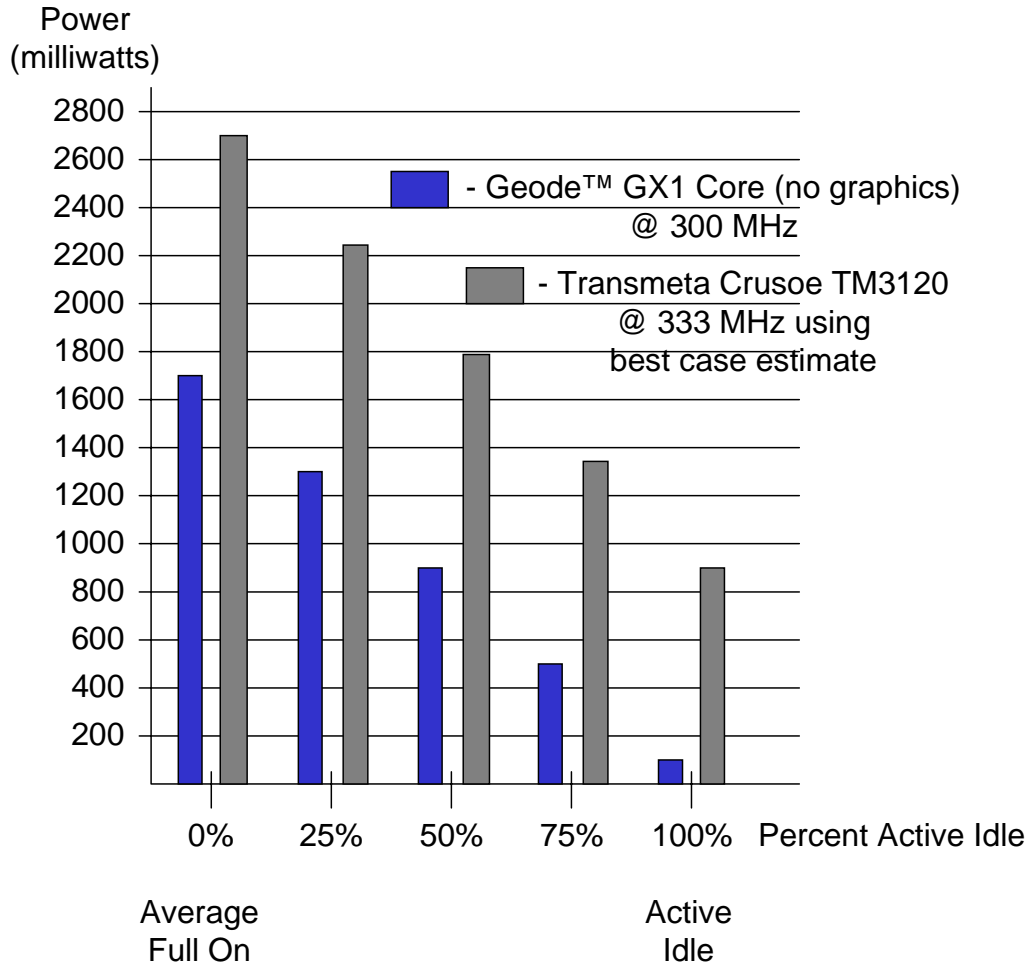


Since the Transmeta TM3120 chip contains no graphics, it is necessary, when comparing its power to the GX1, to remove power consumed by the display controller of the GX1 from the graph. As shown, the power consumption of the GX1 minus the power consumed by the display controller is significantly less than the power consumed by the Transmeta TM3120.

To compare the total GX1 power consumption to the Transmeta TM3120, a display controller must be added to the power consumption estimate for the Transmeta device.

## Conclusion

The data shows that the GX1 core power consumption is superior to that of the Transmeta TM3120. Even when including the GX1 display controller, the GX1 consumes less power. When designing a battery-powered information appliance, the Geode GX1 proves to be the ideal processor.



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